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Abstract

Policymakers around the nation are promoting class-size reduction (CSR) as a means to improve student achievement, especially in the early grades. While research on the effects of reducing class size on achievement is mixed, a recent study of large-scale implementation of CSR in California show modest but significantly positive gains for third grade students in reduced classes (20 students maximum) compared to those in regular size classes. At the same time, most studies of CSR emphasize student outcomes and say less about the mechanisms that may contribute to those outcomes. How might small classes alter the teaching and learning environment? Our previous research comparing teaching in reduced and non-reduced third grade classes describes some differences that may contribute to learning. But theory and research have some way to go to explain this relationship. This paper contributes to the discussion by focusing on two third-grade teachers who switched from large to small classes as the CSR implementation unfolded in California. Using observational and other qualitative data, we examine hypotheses about class size and the teaching and learning environment by looking closely at these teachers' mathematics and language arts instruction. Although we find some differences in line with expectations, overall the learning environment changes remarkably little as these teachers move from large to small classes. We conclude with some speculations as to why this is the case and what it might imply for policy.

Introduction

Policymakers around the nation are promoting class-size reduction (CSR) as a means to improve student achievement, especially in the early grades. The widespread adoption of this policy has appeal for many reasons. Common sense tells us that teaching fewer students in a classroom must have positive benefits for teachers and children alike. Teachers, parents, school staff and administrators, policymakers and the general public seem equally committed to the idea of reducing classes, which creates a powerful coalition in support of educational change. Arguably, few other education reform policies aimed at changing core practices garner such widespread support.

To the extent that policymakers look to research evidence to support class-size reduction they find mixed results. Correlational studies of state policies find little evidence that class size affects achievement. However, experimental studies tell a different and quite compelling story. The most powerful evidence for reducing class size comes from a controlled experiment in Tennessee in which kindergarten students were randomly assigned to small and large classes within participating schools and remained in these classes for two years. Achievement tests in reading and mathematics at the end of each grade revealed a significant benefit to children in reduced-size classes, with some added benefit for minority students (Finn and Achilles, 1989; 1990). Subsequent analyses of the Tennessee data conclude that class size effects are large enough to be important for educational policy and quite consistent across schools. Small classes appear to benefit all kinds of students in all kinds of schools (Nye, Hedges, and Konstantopoulos, 2000).[1]

An earlier study by Cahan, Filby, McCutcheon, and Kyle (1983) observed second grade teachers who had switched from large to smaller classes mid-year. Cahen et al. organized their inquiry around the themes of instructional practices (subjects taught, activities, use of materials, classroom organization, planning, assessment), interactions, interruptions, and external factors (mandates from principal or state). They found that teachers had positive feelings about the change in class size and reported they were enjoying the class more and were changing their own practices. But the researchers observed few actual changes in teachers' instructional practices. The most prominent change was that teachers spent less time giving directions in smaller classes which permitted teachers to have more time to evaluate students' work and assess and respond to students' problems. However, the nature of these responses stayed the same. School variables, such as textbooks in use and principal attitudes, may have contributed to the lack of changes. In addition, since the change in class size was made mid-year, there was no opportunity for

professional development interventions that might have helped teachers change their practices to take advantage of smaller class size.

Our own research on teaching practices and class size also found some significant differences between non-reduced and reduced size classes that are consistent across two years of an ongoing longitudinal study in California (Stasz and Stecher, 1999; Stecher et al., 2000). Results form a statewide teacher survey indicated that teachers in small classes devoted more instructional time to small groups and to working with individual students in language arts and mathematics lessons than did teachers in non-reduced classes. Moreover, teachers in smaller classes spent more time with poor readers and were more positive about their ability to assess and meet student needs and to provide students with feedback. They spent less time disciplining students than their counterparts in larger classes. However, teachers reported few differences in curriculum or learning activities associated with mathematics and language arts instruction.

These empirical studies are suggestive of the means by which smaller classes might contribute to student learning and are also in line with suggestions from other researchers who study teaching and learning. Brophy (2000) notes how improvements might be accomplished by extending or adapting twelve generic principles of effective instruction identified in empirical studies of teaching. For example, he suggests smaller classes can provide a more supportive classroom environment, greater opportunity to learn, broader or deeper curricular alignment, more individual monitoring and assistance, more practice and application activities, or flexibility to teach the whole class, groups, or individuals as needed. These and other advantages would come about primarily through reducing time needed to organize and manage the classroom. Brophy also notes that teachers will need to make adjustments to curriculum, instruction, and assessments in order to exploit the opportunities that smaller classes provide.

Overall, the research on class size has focused more on student achievement than on the mechanisms that may contribute to that achievement. Thus, it is not yet clear *how* small classes lead to higher achievement (Grissmer, 1999; Nye, et al., 2000). In this paper we add to the conversation about why class size seems to matter in student learning by taking a close look at two third grade teachers in California. Over the past three years we and our collegues have been evaluating the effects of the CSR initiative in the state using both qualitative and quantitative methods. One strand of the research consists of a two-year case study of 16 third grade teachers, eight of whom taught in reduced-size classes of 20 or fewer students and eight of whom taught in classes averaging about 29 students. During the second year of the study, two teachers switched from large to small classes, providing a unique opportunity to see how this change affected their

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[1] The literature on the effects of class size has been extensively reviewed. See, for example, Cahen et al., 1983; Glass and Smith, 1978; and Mosteller, Light, and Sachs, 1996. Some studies dispute the positive effects of class size, e.g. Hanushek, 1989, 1999.

views and behavior. Although an analysis of two teachers is by no means generalizable to other teachers and classrooms, it does provide a small window for viewing what does happen when class size is reduced and thus can contribute to the small but growing literature on effects of CSR on the teaching and learning environment.

From previous research and hypotheses about how a smaller classroom environment might mediate improvements in student achievement, we identified the following questions to examine in this paper.

1. Does the change from large to small classes alter the organization or structure of mathematics and language arts lessons? Do the types of activities change?
2. Do teachers alter specific teaching techniques or practices, such as providing more individual attention to students, or grouping them differently for purposes of instruction? Do their methods appear effective?
3. Is there any difference in the cognitive level or content of the material presented to students? Are the lessons and assignments generally grade appropriate? How demanding are the assignments?
4. Do the classes run more smoothly and make better use of available school time? Are transitions smoother? Are students less disruptive and more on-task? Do teacher's management strategies differ?
5. Are teachers' attitudes or views about teaching any different? What value do they see in teaching in a smaller class?

We begin with a brief overview of the study methods and a description of the teachers, schools, and students discussed in this paper.

Approach and Methods

The statewide CSR evaluation study pursued a comprehensive approach in its investigation of the initiative's effects on California schools and students.[2] One strand of this approach consisted of a set of in-depth case studies involving 16 third grade teachers during the second and third years of the CSR implementation[3]. In year two of the initiative (1997-1998), eight of these teachers taught in non-reduced classes and eight in reduced size classes. In the following year, the balance shifted as more schools implemented CSR. Two of the teachers who

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[2] For detail on the full evaluation study methods see G. Bohrnstedt and B. Stecher (eds), *Class-size Reduction in California: Early Evaluation Findings (1996-1998)* (CSR Research Consortium, Year 1 Evaluation Report). Palo Alto, CA: American Institutes for Research. The larger evaluation was conducted by the CSR Consortium, led by American Institutes for Research and RAND, with EdSource, Policy Anlaysis for California Education (PACE) and WestED, with funding from the CDE and several private foundations.

[3] The case study was funded by a grant to RAND from the U.S. Department of Education, Office of Education Research and Improvement.

had taught in non-reduced classes in 1997-1998 had their class size reduced, and two new teachers in non-reduced classes were added to the study to replace those who had dropped out. In 1998-99, 11 of the teachers had 20 or fewer students and five had classes of 28-32 students. Statewide, 80 percent of third grade teachers taught reduced-size classes in 1997-1998: this proportion increased to 90 percent the following year.

The 16 in-depth case studies included interviews with principals and teachers, two content surveys, classroom observations of mathematics and language arts lessons (2 times per year, one of which was videotaped), daily activity logs (two weeks), and collections of student work. The interviews asked a variety of questions about CSR implementation, other educational reforms, teaching practices, and other topics. The content surveys, administered in both years, listed third grade topics in mathematics (116 topics) and language arts (113 topics) derived from the state curriculum frameworks and standards, as well as from the scope and sequence charts and tables of contents from the state-adopted textbooks for grade 3 that were current for 1997-1998. For each topic listed, teachers indicated whether they taught the content as new, as a review, or not at all, and, if they did teach the content, how many class periods they devoted to it. Case study teachers also completed the same teacher survey administered to 1,522 third grade teachers in the larger evaluation study. While this paper draws primarily from the case studies, it makes use of survey data from the larger evaluation for comparative purposes.

In both years, teachers were asked to keep daily logs during a 1-2 week period of their mathematics lessons and of their language arts lessons. Teachers recorded the content and expected learning outcomes for the lesson. Each day they also recorded the amount of time students spent in various grouping arrangements, on specific learning activities, and on different instructional approaches. They also reported information about student participation in class activities, completion of lessons, and classroom behavior. To assess the level of mathematics content in the daily logs, we developed a coding system using the California State Mathematics Content Standards (1999) as a benchmark. By comparing log data to this benchmark, we determined whether the content represented in math activities were at, above, or below third-grade level.[4]

Context: Two Classrooms

The California CSR initiative began in 1996 with the state legislature's passage of SB 1777, a reform measured aimed at cutting class size in grades K-3 from what had been an average of 28 students to a maximum of 20. To our knowledge, the CSR initiative is the largest state educational reform in history—this voluntary program currently costs over $1.5 billion

[4] Two researchers double coded assignments for six teachers to establish reliability. For traditional types of instruction, 90 percent agreement was established on the logs.

annually and affects over 1.8 million students. School districts who chose to participate in the initiative—98.5 eligible districts were participating by the end of the third year of CSR (the 1998-99 school year)—received just over $800 for each K-3 student enrolled in a class of 20 or fewer students.

At the same time, California's schools were undergoing numerous other educational reforms that involved changes in curriculum standards, state assessments (adoption of the SAT-9), bilingual education guidelines, teacher certification procedures, and student promotion policies. Since these other interventions interact with each other and CSR in intricate and complex ways, it is difficult to attribute changes to any single effort. In addition, the sheer size and variety of California's schools and populace add extra complications to any analysis. It is important to first place our two schools and teachers in this broader context.

Ms. King: Vanguard School

Vanguard School[5] is located east of Los Angeles. The student population is primarily Hispanic (55 percent) and Caucausian (22 percent); about 44 percent of students participate in a free or reduced-price lunch program. Sixteen percent of Vanguard's students are classified as English Language Learners (ELL). During the first year of our study, it had reduced first and second but not third grade. Now all K-3 grades have been reduced and average about 20 students. According to a teacher, this was partly due to lack of space, as the site could not accommodate more portable classrooms. The average parent education level of is 2.92 (where 1 = "not high school graduate" and 5 = "graduate school.") Eighty-eight percent of the teachers were fully credentialed. Academically, the school obtained a statewide rank of "7" on the 1999 SAT-9 achievement test, and ranked "9" in a comparison of similar schools.[6]

Ms. King[7] had eight years of teaching experience, six of which were in first grade. She is a certified teacher with an undergraduate degree in Arabic languages and literature. She transferred to the third grade in 1997-1998. In 1998-99, she participated in 3 days of district-sponsored staff development that focused on using math manipulatives, helping low achieving students with reading, the gifted-and-talented program (GATE), and student assessment. She reported that teachers in reduced-size classes had additional staff development and were also assigned aides for language arts instruction. This teacher also had an aide in her classroom for about thirty minutes per day to help with students reading below grade level.

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[5] Because the study was conducted under the promise of confidentiality, we adopt pseudonyms for teachers and schools. School data are from the October 1998 CBEDS data collection, the Spring 1999 Language Census, and the 1999 Stanford 9 student header sheet.

[6] Source: California Department of Education 1999 Academic Performance Index (API). Rankings are reported in deciles with 10 being the highest and 1 the lowest. For statewide ranks, each decile contains 10 percent of all schools. For similar schools ranks, each decile contains 10 percent of the 100 most similar schools.

[7] The teacher profiles are abstracted from the teacher interview conducted in the first year of the case studies.

Her non-reduced class had thirty students. Ms. King followed the district math curriculum framework, which is based on the state framework. Since she was new to the school, she had only been using this framework for about a year. Her instructional goals for her students were fairly straightforward: to be able to add, subtract, multiply and divide and to solve problems. Although the class sometimes used computers in math or played mathematics games, she said that most of their activities followed their math textbook. She sometimes grouped students for math activities in mixed-ability groups or in pairs. Although she gave some homework in mathematics she did not count it as part of the students' grades.

Ms. King also reported using state and district frameworks in her language arts curriculum. At the end of grade three, she wanted students to be able to write in paragraphs and to read and comprehend at grade level. Her basic language arts activities included daily journal writing, reading aloud, completing worksheets and workbooks and writing poems. She also had regular story times. Students were grouped by skill level, determined at the beginning of the year with a district test. As a student progressed, he or she was moved to a new group. During language arts, Ms. King spent about 30-40 minutes with each group from Monday through Wednesday, when a volunteer was present in the class. On Thursdays, the two higher groups worked independently, while she worked with the lowest reading group. Fridays were reserved for whole class activities or partner reading. Every quarter students took a district-designed timed writing test. She felt that about a third of her students were not prepared for third grade work.

Ms. Lane: Stringfield School

Stringfield School is located in southern Los Angeles County. It is a large K-5 school with just over 1000 students. The student population is primarily Hispanic (53 percent) and African American (24 percent). About 86 percent of Stringfield students participate in a free or reduced-price lunch program, and about 49 percent are designated as ELL. According to the principal, the school first reduced grades 1 and 2, followed by kindergarten and finally third grade. The average class size in K-3 is 19 students. The average parent education level is 2.33. Only about 60 percent of Stringfield's teachers were fully credentialed. The principal reported that thirteen new teachers were hired in the first year of CRS, a faculty increase of 50 percent. Since about half of these teachers were new or had only one year experience, the principal reported paying more attention to staff development to provide support for these teachers. Academically, Stringfield ranked "5" on the statewide test comparison and "10" on the similar schools comparison.

Stringfield's third grade teacher, Ms. Lane, had been teaching for 10 years, virtually all in grade three. She holds a B.A. degree in liberal arts. Ms. Lane described herself as a loner who

does not socialize with other teachers or go to the teachers' lounge, preferring to spend breaks alone. She said the district provided four staff development days per year, but that teachers in reduced size classes had more. She had a non-instructional aide in her class about 6 hours per week, but also said that the aide helped tutor individual children in reading. She said she did not regularly group students for instruction, nor work with them on an individual basis.

Ms. Lane had followed the district mathematics curriculum standards for about three years. Most of her students were unprepared for third grade math in her opinion. Second grade teachers had told her that the new math series for grade 2 did not cover all the topics that students should know to be prepared for the grade 3 curriculum sequence. By the end of grade 3, Ms. Lane wanted students to know all the basic facts, money, operations, tell time to the minute, know geometric figures, and be introduced to metrics and standard measurement. Her main activities included worksheets, manipulatives, math games and finger math. To assess students' math capabilities, she used her own beginning of year assessment, previous year test scores and teachers' reports, and district basic facts tests.

The district also had standards for language that specified reading levels for grades 3 to 5. The third grade benchmarks included working independently and writing an autobiographical incident and problem/solution. In one of the lessons we observed, Ms. Lane conferenced with students to give them feedback on their written autobiographical incidents. Thus, she was definitely incorporating the district benchmarks into her instruction. The main activities included poems and songs for grammar practice, story time, writing assignments, math journal, reading on their own, reading aloud, worksheets, and the Reading Rabbit computer program. Unlike most teachers in the case studies, she did not group students for language arts instruction.

Findings

In this section we consider our five research questions for each teacher and compare different aspects of their teaching and classroom before and after class-size reduction. We describe the overall organization and structure of the four language arts and mathematics lessons as recorded in fieldnotes and/or videotapes (question 1). For the remaining questions, we focus on the second mathematics lesson each year (which were videotaped), first in the non-reduced class (year 1), then in the reduced-size class (year 2). We chose to report on the mathematics lessons because our analysis of these lessons is more complete. We begin with Ms. King.

Ms. King

1. Organization and structure of lessons and activities

Teachers typically organize their teaching around instructional activities, which may vary according to the content of the lesson (Stodolsky, 1988). It is reasonable to assume that when

teachers have fewer students they may alter these activities. They may experiment with activities that seemed too difficult to manage in a larger class. They may group students differently for instructional purposes or they may decide to teach to the whole class, since having a smaller number of students may make that option more effective (Stasz and Stecher, 1999).

To get a sense of the overall structure of these teachers' lessons we created activity "maps" to describe the activities which make up the mathematics or language arts lessons along several dimensions: lesson content, grouping (e.g., whole class, small groups), teacher interaction with students (with group, with individual student), and non-teaching transitions. The maps were developed from fieldnotes and videotapes.

Non-reduced class (year 1). Ms. King's lessons are illustrated in Figure 1. Turning first to the overall pattern for year one, Ms. King spent a little more time on language arts than on mathematics, separating the lessons by recess. The structure of language arts activities was similar in the two lessons: students are organized into groups and either worked alone or with a teacher or aide. Lesson 1 (Figure 1) began with an introduction of the bookmobile activity to the whole class, after which the teacher spent most of the time with one reading group, while the rest of the students worked independently on three activities: bookmobile, copy and answer questions at the end of the story, and complete a spelling assignment. In language arts lesson 2, the teacher worked with one group on homophones and vocabulary, a volunteer worked with one reading group, and the remaining students worked individually on a spelling task. Toward the end of the lesson, the teacher spent about 10 minutes with a different group on reading comprehension.

The organization of the mathematics lessons in this large class were more different than alike, although in both lessons the students worked with manipulatives. In math lesson 1 they used dominoes in a lesson on fact families. The teacher first reviewed fact families for about 10 minutes. Working on his or her own, each student wrote four facts using the numbers on his or her domino (e.g., $3 \times 0 = 0$; $0 \times 3 = 0$; $3 / 0 = 0$; $0 / 3 = 0$). In the final 10 minutes of the lesson, the teacher asked eight students to write their problems on the board. At the teacher's prompting, the class gave "thumbs up" or "thumbs down" to signify whether the problem was correct. The teacher corrected any errors on the board.

In math lesson 2 (described in more detail in the next section) the students used popsicle sticks and worked in pairs on an activity concerning division with remainders. The teacher closely guided the activity In this case, the use of pairs was not a purposeful instructional or pedagogical technique, but a function of the number of popsicle sticks available. Some student pairs worked cooperatively and took turns using the sticks, while in other pairs one student used the sticks while the other looked on.

Reduced-size class (year 2). Turning to the overall pattern in the reduced class, we see similarities in the two lessons, but distinct differences from the year one pattern (Figure 2). First,

in year two Ms. King began both classes with a short language arts activity, followed by a mathematics lesson and a longer language arts lesson. In year one, she had elected to teach language arts, then mathematics. Second, the sheer number of different activities and topics in each lesson increased from year 1 to year 2, although the length of the lessons was about the same (1 hour). Math lesson 3 consisted of three separate activities and lesson 4 included five activities. In year one, the math lesson included only one or two activities on the same topic. The language arts lessons followed the same general pattern as the previous year, combining group work with the teacher or an aide and independent seatwork. Language Arts lesson 3 also incorporated several different activities. Third, the overall length of each type of lesson reversed: in year one she spent more time on language arts, in year two more time on mathematics.

In year two, Ms. King began both observed classes with a short, 15 minute writing activity. The purpose of the first activity in Lesson 3, for example, was "to learn about the letter D." Ms. King first demonstrated on the board how to write the letter. Students completed a cursive writing worksheet, while the teacher circulated to check their work. Worksheets were followed by a mathematics lesson, which, as the year before, combined whole class instruction with seatwork.

Lesson 3 began with a story on "Two of Everything" (15 minutes), followed by whole class instruction and seatwork on multiples of two (20 minutes). Students completed worksheets, which included pictures that illustrated the concept (e.g., 3 cookies on each of two plates). Nearly half of mathematics lesson time (25 minutes) was spent on correcting homework. Students were asked to go to the board and add a column of numbers the teacher had written. Compared with year one, these mathematics lessons appear to consist of shorter activities and cover at least two topics. Math lesson 4 (discussed in more detail in the next section) began with a 15 minute activity to complete a math worksheet. Next the teacher guided students in a recitation of multiplication tables and administered a five minute multiplication test. The teacher then taught a lesson on strategies for solving word problems, after which students completed a worksheet on word problems.

2. Teaching practices and techniques

In addition to the structure of activities discussed above, we can see whether teachers' approaches and techniques, such as providing more individual attention to students, frequency of guided practice, and so on, varied from non-reduced to reduced size classes. Previous research suggests that teachers in reduced classes are able to provide more individual time with students, so we might expect to see more individualization in year 2.

Non-reduced class (year 1). To get a sense of Ms. King's teaching techniques and their effect on students, we closely reviewed the videotapes of mathematics lessons 2 (non-reduced class) and 4 (reduced-size class). There were 30 students on the day of our observation in year one, seated at tables in five groups of six. The room was crowded with little room between tables. In addition, the walls and blackboard were crowded with signs and student work, with little room for writing.

At the macro level, lesson 2 was framed in a recognizable way, as follows:

- Introduction: "learn about division with remainders"
- Engaging example: Bring five students to the front of the room and divide them into groups with remainder
- Hands-on activity: Divide popsicle sticks into groups
- Closing commentary: the "trick" that the number of groups times the number of sticks per group plus the remainder equals the number started with
- Future direction: tomorrow's lesson will be dividing without sticks

Ms. King first demonstrated the grouping activity with real people. She called 5 students to the front of the class and divided them into 2 groups of two students, with one student "remainder." She then incorrectly wrote on the board "5/2 = 4R1" (the correct answer is 5/2 = 2R1). The teacher handed out popsicle sticks and assigned problems to be done in pairs. She circulated around the class to see how the students were doing and to offer individual help. She prompted students who were not taking turns with the sticks to do so. When the teacher determined that enough students had completed a problem, she recorded the answer in a table on the board, checked that all groups got the correct answer, and assigned another problem. The columns in the table where the teacher recorded the results were not labeled, which made it harder to follow. This process was very slow: only 7 or 8 problems were solved in 50 minutes. At one point Ms. King suggested that students count sticks by fives in order to speed up the activity. But this suggestion seemed only to confuse some students.

Conceptually, the elements of the lesson were never explicitly linked together. The teacher did not explain nor elicit an explanation of how sorting sticks into groups was associated with division. In fact, division was never mentioned during the major activity with the sticks. Rather, the discussion concerned "groups" and "sticks per group." The teacher discussed "how many groups" and "how many per group" but nothing was said about the equivalence or non-equivalence of these concepts, or how they related to division. The students did not seem to understand the difference.

Reduced class (year 2). Ms. King's reduced class had only seventeen students at the time of our visit: one was out sick, and two of the original twenty students had left permanently. At the start of the class, students spent about 15 minutes on a writing assignment. As they finished, the teacher instructed them to begin the math exercises listed on the board. As they completed their math worksheets, the teacher circulated around the room and answered students' questions. The math activity involved rounding three digit numbers to the nearest hundredth.

Ms. King put a CD in the audio player to review mathematics times tables. Students began singing the "3 times" table to the music of a popular tune. Students repeated this for multiplication by 4, 5, and 6, singing with different tunes. Some students seemed engaged in this exercise, while others seemed embarrassed. The students had trouble with the 6 times tables, and the teacher wrote the multiples of 6 up to sixty on the board. She pointed to the multiples as students sang. For the "7 times" table, she changed the music and asked a few students to come to the front of the room to dance and sing. The students recited the multiples of 7 while singing and dancing to the tune of the Macarena.

Next, she gave students a 5 minute multiplication test which was administered weekly. The student took a different test according to his or her performance on the previous test. Students finished quickly and Ms. King asked them to bring their papers forward. None of the students were tested on multiplication higher than 7.

Once the review and test was completed, the teacher began a lesson on word problems that followed an organized pattern:

- Introduction: "learning strategies to solve problems"
- Guided practice: teachers works through three worksheet problems together with students.
- Independent practice: students complete worksheet on their own.

Ms. King began by asking students for "clue words" for addition and subtraction. She read word problems, e.g. "Twenty kids are in the class, one leaves. How many are left?" Students were able to solve this math problem and identify the mathematical operation (subtraction) but could not identify the clue word. Ms. King handed out a worksheet that listed clue words and went over the instructions. She worked with the students on three problems, asking some to come to the board and write a concluding sentence that contains the solution (e.g., "Nineteen students are left in the class"). Students underlined the clue word in each problem. As students completed worksheets on their own, the teacher answered questions, but did not systematically check students' work. As they handed in the worksheets they turned to journal writing. The lesson ended with recess.

Individualization. The opportunity to work one-on-one with students is seen by many as one of the chief advantages of reducing class size. Ms. King reported having little time to work individually with students in her large class. She did not tutor students one-on-one during class time, but sometimes met with them during lunch or after school. When asked how many times in the last week she had spoken with a child about his or her learning program for at least ten minutes, she replied "zero".

In her reduced size class, Ms. King did not appear to increase level of individualization. Her math lessons were presented to the whole class, and she did not intervene or look at students' work unless asked. After lesson 4, she presumably looked at the worksheets to determine whether students could identify clue words and solve the simple word problems covered in the lesson. But during the math classes, we saw little evidence of individualization, although she reported sometimes using small groups in math when she identified a few students who seemed to be having problems.

3. Curriculum content and coverage

In terms of curriculum content, Ms. King's second mathematics lesson began with an exercise on division that corresponds with a second grade content standard. The worksheet, "Exploring division facts with remainders," consisted of a table where students were given a total and either a number in each group or a number of groups. The student needed to fill in the missing blanks. For example:

Total	Number in Each Group	Number of Groups	Number Left Over
23	5		
21	6		
28		3	
39		9	

The table was followed by twelve simple division problems (e.g., 25/3, 19/2) and the instruction to "Use counters to find each quotient".

In lesson 4, Ms. King's main activity was also second grade level. Students were asked to identify and underline clue words for addition (e.g., in all, altogether) and subtraction (e.g., how many more, how many left) in word problems, solve the problem, and write a complete sentence that included the answer. For example: "The class painted 10 pictures on Monday and 13 pictures on Tuesday. How many more pictures did they paint on Tuesday?"

The teacher content survey indicated that Ms. King taught about the same number of mathematics topics in her reduced and non-reduced classes (97 and 93 topics, respectively), but that she taught slightly more third grade topics in her reduced-size class (23 and 19,

respectively). She also reported spending longer periods of time on more topics in her reduced class: she spent 10 hours or more on ten topics in her reduced-size class, compared to 2 topics in her non-reduced class (see Table 1).

Table 1: Ms. King's Mathematics Lessons Content

	Year 1			Year 2		
	Teacher 15 Non-reduced	Mean All teachers	Mean Non-reduced	Teacher 15 Reduced	Mean All teachers	Mean Reduced
Topics Taught	93	96	90	97	98	100
Topics Taught 10+ hours	2	25	27	10	25	21
Third Grade Topics Taught	19	22	25	23	31	32
K-2 Topics Taught	24	13	13	20	11	11

Finally, her teacher logs for year one show that the lessons averaged at the third grade level (seven of 10 days). In year two, about half the lessons over five days were at second grade level and the remaining at third grade.

4. Classroom management and transitions

From the outset of Lesson 2 (popsicle sticks), Ms. King actively managed the noise and attention level in the class. For example, she said "shhh" repeatedly and almost continuously throughout the lesson, gave praise to tables by name (colors), and jingled a little bell when the noise level grew too loud. Her actions seldom became oppressive, but were constantly present. Once she punished a student with the loss of 10 minutes of recess for being out of his seat. Students were generally in their seats, working on the lesson, but the noise level was notably high.

In year two, some aspects of Ms. King's management style were strikingly different. She seldom attempted to quiet students at all. The class was generally quiet and orderly. Students knew what to do when they entered class after assembly and immediately got down to work. In both years, transitions between activities proceeded smoothly.

5. Perceptions about teaching in reduced-size classes

Teacher interviews provided opportunities to determine teachers' perceptions about class-size reduction. When Ms. King taught in a non-reduced class, she speculated that the most important benefit of teaching in a reduced-size class would be more time to work with individual students. For the lessons we observed, however, she did not individualize her instruction to any

great extent. In the post-observation discussion, Ms. King felt the lesson on problem solving strategies (lesson 4) went faster than she had anticipated "because I was able to go around and help quicker" as students completed worksheets. In general, Ms. King felt the students in her reduced class seemed to grasp concepts more easily. She attributed this partly to the difference in class size and partly to differences in student ability.

Ms. Lane

1. Organization and structure of lessons and activities

Non-reduced class (year 1). Ms. Lane's activity map for year one is shown in Figure 4. Ms. Lane spent nearly twice as much time teaching language arts than mathematics: both math lessons lasted about 45 minutes each. In lesson 1 the class began with oral reading involving the whole class. Students read aloud in unison, while the teacher circulated throughout the room, stopping to encourage non-readers, quiet readers, or readers who had lost their place. She also joined in intermittently. Following oral reading, students took a multiple choice language arts test. After the test, the teacher administered a prompted writing assignment. Students were instructed to write and illustrate a letter to the principal about upgrading the playground. While students wrote, she called three to her desk to administer the district-required "benchmark" test.

In lesson 2, she again began with a whole class activity, this time a vocabulary drill, where students arranged words alphabetically on the board. Students choose three words to illustrate and continued with their illustrations or another writing task for the remainder of the lesson. Three students worked with an aide for about 25 minutes. During this time, the teacher held individual "conferences" with students on their writing. Each conference lasted about 2-3 minutes.

The mathematics lessons also combined both whole class instruction and independent seatwork. In lesson 1, students began with a math "maintenance drill," followed by a lesson on shapes and perimeter. The drill consisted of a 6 items and was used by the teacher to help assess whether or not she needed to re-teach a topic. The teacher introduced the lesson and discussed shapes and perimeter, then students worked independently to complete their worksheets. Math lesson 2 also began with a timed test, and also covered the topics of area and perimeter (described in more detail in the next section). The teacher's lessons followed the same basic structure, first teaching to the whole class, then assigning independent seatwork.

Reduced size class (year two). In year two, the overall structure of the lessons was quite similar (Figure 5). Ms. Lane continued to spend nearly twice as much time on language arts than on mathematics. She continued to teach to the whole class, followed by independent seatwork in both language arts and mathematics. The absence of any kind of group activity, especially in language arts is somewhat unusual, compared to other teachers in the case studies and for the

sample of teachers surveyed statewide. It is much more typical for teachers to group students, particularly in language arts lessons where students are often homogeneously grouped by reading ability. In both lessons and both subjects more of Ms. Lane's class time is spent in whole class instruction, as compared to year one. We also see that Ms. Lane tended to increase the number of activities in the reduced-size class as compared to the non-reduced class.

Ms. Lane described her own style as "organized and routine" which reflects her personality and her judgment of what the children need. She felt it made students more secure when they knew what was going to happen.

2. Teaching practices and techniques

Non-reduced class (year one). To get a sense of the overall quality of Ms. Lane's teaching, we again focus on the two mathematics lessons that were videotaped. Twenty-six of 30 students were present on the day of our visit in year one. As outlined above, lesson 2 followed a fairly traditional model of "teacher exposition," although it was poorly executed with confusing transitions and little overall sense of where the lesson was going:

- Review previous knowledge and define new terms, working an example
- Guided practice: teacher works step-by-step with students to find the perimeter of four shapes. A very slow process taking 30 minutes.
- Individual practice: students complete worksheet, with brief summation by the teacher at the end.

This lesson was teacher-directed in the extreme. Students were asked for, and provided only minimal responses: raising hands when they were done, giving the perimeter of a shape when called on. Only two students in the entire lesson were asked to elaborate on a response, i.e., how they counted up the perimeter for the rectangle and the square, respectively.

Reduced size class (year two). Eighteen of the nineteen students in Ms. Lane's class were present for the fourth observation. The teacher's lesson followed the general structure used in the non-reduced class, but seemed to proceed more quickly. She first reviewed what they had done the day before: draw shapes and measure the perimeter by counting boxes and squares. She told student the purpose of the day's lesson was to "learn how to estimate area" and she reviewed the definition of area written on the board. She asked students to do the first problem in their textbook, a figure shaped like the letter E. Several students made incorrect guesses, to which the teacher replied "I don't think so." Finally, someone gave the correct answer and Ms. Lane solved the problem on the overhead. She colored in the grid using one color for squares that were completely covered by the "E" shape and another color for squares only partially covered. She counted the fully covered squares (six) and the total number of squares in the

figure (ten). She said the estimated area was 6 to 10. Essentially, her example used the number of fully covered units as the lower bound, and the number of fully plus partially covered units as the upper bound of the estimate. The teacher continued in a guided practice mode through several problems.

When the worksheet was completed, Ms. Lane handed out "homemade" graph paper that depicted four axes. The task was to first use number pairs to construct a shape and then to estimate the area of the shape. The teacher called off coordinates for points (e.g., 1, 4; 2, 4) then line segments. Students appeared to be following these directions, but it became quickly apparent (to the observer) that they were not producing closed polygons. The teacher repeated the number pairs and line segments to see if the students could catch on a second time. Then she abruptly stopped the lesson and said they would continue tomorrow. She spent the last five minutes of the class showing flash cards with one-digit addition problems. Students responded by calling out the answers more or less in unison.

This activity was clearly ineffective and had a number of problems. First, the teacher complicated the task by having student first make the shapes, then estimate them. Because they could not make the shapes, they never got to the purpose of the lesson. Second, the student worksheets depicted unlabeled axes that marked intervals but without a grid overlay. As students had no grid on which to count it is not surprising that they had difficulty finding and plotting the coordinates. Finally, the teacher failed to monitor student performance and did not seem to realize that over a third of the class were completely lost. During the estimation task, she also failed to systematically monitor the students' progress. As with the earlier class, the teacher demanded little in terms of student response. During the second task, for example she admonished students: "Don't try to figure out what it [the shape] is. You make mistakes when you start thinking about it."

Individualization. Ms. Lane's mathematics lessons were directed predominately to the whole class, with the teacher talking to and asking questions of the entire class. In a few instances, the teacher made remarks to an individual student for behavior management purposes. One instance of substantive feedback to an individual student toward the end of mathematics lesson 2 was in such a loud voice that it became a comment directed to the whole class.

The activity maps indicate that Ms. Lane appeared to spend more time working with individual students in her non-reduced class than in her reduced class, especially in language arts. This finding goes against previous analyses, which indicate increased individualization with class size reduction (e.g., Stasz and Stecher, 1999, in press). However, the nature of this one-on-one interaction in large classes was very specific. Once the seatwork activity began, the teacher used the time to do "benchmark" assessments with three students or to conduct individual "conferences' with students about their writing. These individual conferences lasted

about two minutes each and Ms. Lane conducted about 8-10 of them. The conferences were fairly scripted. The teacher asked the student to read his or her piece aloud and fill in any missing parts of the assignment. The assignment itself was a prompted writing task beginning with "I want to tell you about the time" and following an outline: where, when, why, and how you felt. The teacher usually made positive comments, however innocuous (e.g., I like how you remembered that date). This assignment mirrored the task assessed on the district benchmark tests.

3. Curriculum content and coverage

The content of Ms. Lane's math assignments and activities was fairly low level and required only minimal response from the students. The content of lesson 2 was quite basic, when compared to the California mathematics content standards. The mathematics maintenance drill, for example, tested addition and subtraction at a level expected of first and second graders, and multiplication at a level expected of third graders. The exercise on finding area and perimeter is at grade three level. The topics for math lesson 4 included finding area by counting (grade 3) and coordinate graphing (grade 4). The flash card sequence at the end of the aborted graphing activity was simple addition (grade 1). Unfortunately, the highest level activity failed miserably.

The teacher content survey indicated that Ms. Lane taught fewer topics in her reduced class compared to her non-reduced class (89 and 106 topics, respectively), that fewer of these were third grade topics (29 and 32 topics, respectively) and that slightly more were K-2 topics (13 and 11 topics, see Table 2).

Table 2: Ms. Lane's Mathematics Lessons Content

	Year 1			Year 2		
	Teacher 12 Non-reduced	Mean All teachers	Mean Non-reduced	Teacher 12 Reduced	Mean All teachers	Mean Reduced
Topics Taught	106	96	90	89	98	100
Topics Taught 10+ hours	N.A.	25	27	15	25	21
Third Grade Topics Taught	32	22	25	29	31	32
K-2 Topics Taught	11	13	13	13	11	11

The teacher logs for mathematics in year one (14 days of lessons) indicated that the content of Ms. Lane's lessons ranged from grade levels 2-4, with about half of the lessons at the grade 3 level and about half at second grade level. In year two (5 days of lessons), four lessons were judged to be second grade level and one third grade. Overall, the mathematics content was at the third grade level or lower.

4. Classroom management and transitions

Ms. Lane's management style was very directed and controlling in both size classes. In math lesson 2 (large class) for example, there were no disruptions at all during guided practice and only a few towards the end of individual work. Such disruptions as did occur were dealt with bluntly: for example, "Sam, did you want to spend more time with me? I don't think so."

An interesting difference in Ms. Lane's teaching in non-reduced versus reduced size classes concerns transitioned between activities. In the non-reduced class, Ms. Lane's lessons began and/or ended with non-instructional transitions lasting from about 5 to 10 minutes (See Figure 4). In lesson 1, these transitions sandwich the language arts activities; in lesson 2 we observed such transitions at the beginning of language arts and mathematics. For example, the 10 minutes transition in language arts lesson 2 was partly due to "pencil sharpening time," when the teacher on students by row and sharpened their pencils for them. In the reduced size class, however, these lengthy transitions disappeared, suggesting that Ms. Lane was better able to manage the process of changing activities. In addition, we noticed a little more student participation in the reduced size class (e.g., more students raising their hands) and fewer instances of the teacher reprimanding students or having to remind them to pay attention. Although her overall behavior was quite controlling in both size classes, in the reduced size class she provided more positive feedback to the class and to individual students than she had in the non-reduced class.

5. Perceptions about teaching in reduced size classes

When interviewed in year 1, Ms. Lane thought that reducing class size would mean less work for her over the weekend and more time to try new things and to individualize instruction. The post observation interview conducted after the fourth visit provided some interesting information about Ms. Lane's view of teaching in smaller classes once she had experienced it. She had taught the lesson the previous year to her large class but did not expect it to proceed any differently in a smaller class. She felt that math was not different with a reduced or large class because there was a set amount of curriculum to present and a certain amount of time. In her view, "its not the amount of kids but how well prepared they are for third grade that matters." The teacher also felt the first part of the lesson was successful, but the second part—where they first had to draw then estimate the area of the shapes—did not go well. She felt the activity was perhaps "too much concentration for most students" and that it might be better to first just review number points.

The teacher said she does not often use manipulatives in class "because students want to play with them." She thought they got distracted from the math because they did not have many toys at home. She used beans for counting because it was less distracting than using blocks.

Ms. Lane noted several differences between her non-reduced and reduced-size classes. The class itself was more unified, but it had been harder to teach because, in her view, the students were unprepared. She said she was usually given lower ability students, but that 11 students in her current class scored in the 13th percentile or lower in reading. Only five of her students scored at average or higher on the SAT-9. It made the lessons harder to teach because a majority could not grasp the concepts. She reported doing less writing and independent work with these students. She partly attributed the problem to the number of new teachers on emergency credentials in the earlier grades.

Summary and Implications

This close-up view of two teachers who switched from non-reduced to reduced size classes admittedly covers only a small sample of their teaching practices. Although we can not make definitive conclusions about their teaching from these data, the results are both interesting and suggestive. Several aspects of their teaching stand out.

First, the overall structure of the lessons and the activities within them did not differ much from year 1 to year 2. Both teachers seemed to increase the number of activities carried out within their lessons, especially during mathematics lessons. This pattern mirrors what we found in our year one comparison of teachers in reduced size and non-reduced classes: teachers in reduced classes reported "doing more" than they had in larger classes. In an analysis of student activities recorded on teachers' logs, reduced size classes did more of most activities, with the greatest differences being in complex activities. Similarly, responses from the statewide teacher survey indicated that students in reduced size classes engaged in the majority of mathematics activities more frequently (in absolute terms) than students in non-reduced classes (Stasz and Stecher, 1999).

Second, we observed little difference in teaching practices from year 1 to year 2. Ms. Lane's practices seemed especially robust from year to year, following the "exposition, guided practice, individual work, summary" model. She did not change her grouping practices at all, preferring to teach to the whole class irrespective of class size. Ms. King, on the other hand, reported using more groups in mathematics when students had difficulties, but we did not observe this change in her lessons. Her grouping practices in language arts looked similar from year-to-year. She typically worked with one group of students for most of the time period, while other groups did individual seatwork or worked with an aide. Compared to other teachers, Ms. Lane's practice was unusual: most teachers who participated in the case studies and statewide

survey grouped students instructional purposes. Furthermore, the size of groups generally corresponded to the size of the class. Teachers in reduced size classes tended to teach groups of 2-3 students, while teacher in non-reduced classes taught groups of 4-5 students and were also more likely to teach to the whole class (Stasz and Stecher, 1999). Overall, these two teachers still favor the "whole class" approach over grouping strategies.

These teachers did not tend toward individualized instruction even after they moved to smaller classes. Ms. Lane's individual work with students was exclusive to carrying out the district's benchmark assessments. Neither teacher seemed to do an especially thorough job of monitoring students learning during the lessons except when they adopted a guided-practice strategy of working problems one-by-one. This finding is interesting, partly because both teachers, when they were still teaching a non-reduced class, speculated that the ability to individualize instruction would be the major benefit of teaching in a reduced size class. It may be that these teachers' tendency to teach to the whole class made it particularly difficult to switch to more individually-based instruction despite the opportunity the reduced size class provided.

The content of the mathematics lessons did not appear to change significantly for either teacher. They stayed fairly closely to the topics intended for grade three or for earlier grades. This result is also similar to findings from the statewide teacher survey, where teachers in non-reduced and reduced size classes reported covering the same general topics in mathematics and in language arts and for similar amounts of time (Stasz and Stecher, 1999). It is possible that the similarity in the breadth and depth of topic coverage reflects the influence of the state curriculum guidelines, although Ms. Lane seemed most influenced by district curriculum standards. In at least two observations, we noted language arts activities geared directly to district tests. At any rate, to the extent that standards did influence these teachers, then differences from year to year would not necessarily be expected.

However, even if the topics do not differ, one might expect or hope for more innovation in teaching practices. It seems reasonable to expect that with fewer students, teachers in reduced size classes may try different kinds of student activities to help enhance learning. These teachers seemed to rely most heavily on more "traditional" methods, with an emphasis on practicing computational skills and doing math worksheets or problems in textbooks. More reform-oriented practices might include added focus on conceptual understanding of mathematics or a more open-ended questioning strategy to elicit students' thinking about math. Ms. King reported having staff development on the use of manipulatives in mathematics and she did so in her lessons. But, as noted above, these lessons were conceptually weak in that the relationship between the grouping activity (with popsicle sticks) and the concept of division were not clearly explained. Ms. Lane's classroom was nearly silent of student talk, as she closely directed the class action and rarely asked questions that required a thoughtful or reflective response.

The fourth question that we investigated concerned classroom management. Here we noticed a few changes. Ms. King's class in year two seemed quite different, primarily because she did not quiet students all the time. The noise in her reduced size class was apparently more tolerable and thus she did not feel the need to continually remind students to be quieter. Ms. Lane's management style did not differ much. She was still clearly in control of the action in her classroom, but she also seemed to provide more positive feedback to students in her reduced size class. In both cases, the amount of time and energy devoted to discipline, order, and transitions declined with the small class.

Finally, teachers' perspectives about CSR were not borne out when they actually had smaller classes. Both anticipated substantial changes, but found things were much the same. Neither teacher seemed to take advantage of the opportunity to individualize instruction when teaching fewer students, although Ms. King seemed more inclined to discuss her teaching as having moved in this direction. For example, she reported being able to "dedicate more time to each student." Both teachers, however, discussed student ability or student preparedness as a significant factor. Ms. King, for example, noted that "some years you have students stronger in a particular subject." Ms. Lane attributed her difficulties to student ability or to lack of preparedness and cited the influx of non-credentialed teachers in earlier grades as a possible source of the problem.

We are unable to say whether these two teachers are more unique or more typical in their response to CSR as compared to most teachers. However, to the extent they are more typical, these results suggest that the proposed benefits to teaching in smaller classes are not automatic. As Brophy (2000) points out, if teachers do not change their behavior to take advantage of smaller classes, then their students will not likely reap all the benefits that smaller classes might afford. In the case of these two teachers, the consistency in their teaching is perhaps a reflection of their individual skill or lack thereof. Ms. Lane, who had the most experience, was perhaps most set in her approach. As discussed earlier, we judged neither teachers' mathematics lessons as particularly exemplary. On the other hand, in the sample of case study teachers we observed over two years, we found very few instances of "innovative" practice as described by mathematics educators or scholars.

Or their expectations may not have been met because of their existing attitudes. Both teachers seemed to emphasize student ability as the primary factor in their own ability to be successful or not. Perhaps these teachers did not view CSR as an opportunity for *them* to change. As a result, they may be adopting a somewhat passive role in the change process and are not actively thinking about what they might do differently.

For these two teachers, and we expect for many others, class-size reduction is not the proverbial silver bullet. Our analyses of the case study teachers and two years of survey data

from several hundred third grade teachers (694 in year one and 636 in year two) show only a few small differences in instructional practices between non-reduced and reduced size classrooms. The few differences noted, however, are encouraging and we do not discount them. In addition, CSR has positively affected most teachers perceptions: they overwhelmingly report that smaller classes provide opportunities for more individual contact between students and teachers (Stecher, et al., 2000). Although survey data are silent on the nature of that contact, these results are still encouraging. On the other hand, the year-two survey found that two-thirds of teachers in reduced size classes still found it hard to meet the instructional needs of all their students (Stecher et al., 2000).

The findings reported here and in our prior writing are consistent with the limited research literature on teaching behaviors and class size. For example, Molnar et al. (1999) and Betts and Shkolnik (1999) also found that teachers in large and small classes used similar teaching techniques and covered similar breadth of content. Teachers in small classes continued to use "teacher-oriented, teacher-controlled teaching," though they were more likely to individualize instruction through one-on-one interaction with students (Molnar et al., 1999, p. 173).

Our findings are also consistent with research that suggests teaching practice is resistant to change and that teachers adapt their practices slowing and marginally as new materials and techniques are introduced (Cohen, 1990). Rice (1999) suggests that teachers need to be trained in instructional techniques that are effective in smaller classes. This may be the case. But it may also be that good teaching is good teaching, a view shared by many of the teachers and principals we have talked to in the course of our work. It is certainly the case that the precise mechanism by which smaller class size contributes to student achievement remains elusive.

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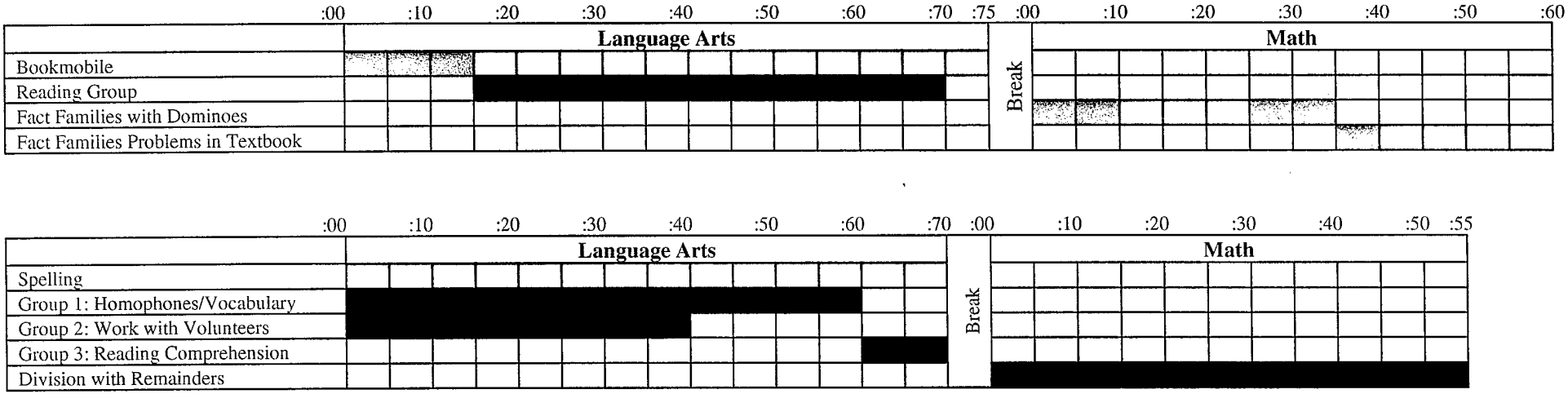
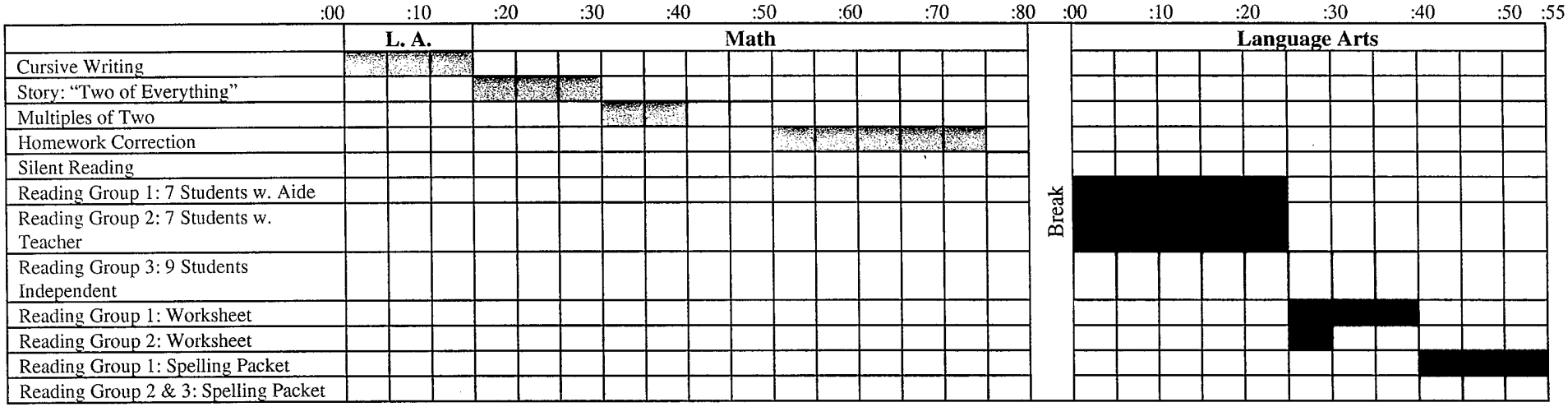
Figure 1. Ms. King, Large, Lesson 1 and 2



Key

- Independent Work
- Whole Class Instruction
- Group Work (Pairs or Small Groups)
- Small Group Instruction with Teacher
- Small Group Instruction with Aide/Volunteer
- Transition
- One-on-One Teacher-Student Interaction

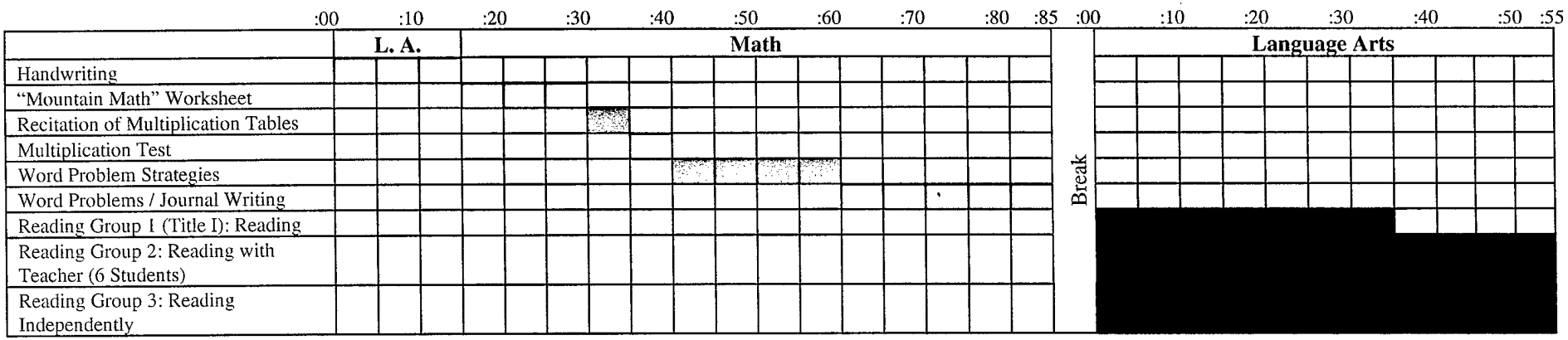
Figure 2. Ms. King, Small, Lesson 3



Key

- Independent Work
- Whole Class Instruction
- Group Work (Pairs or Small Groups)
- Small Group Instruction with Teacher
- Small Group Instruction with Aide/Volunteer
- Transition
- One-on-One Teacher-Student Interaction

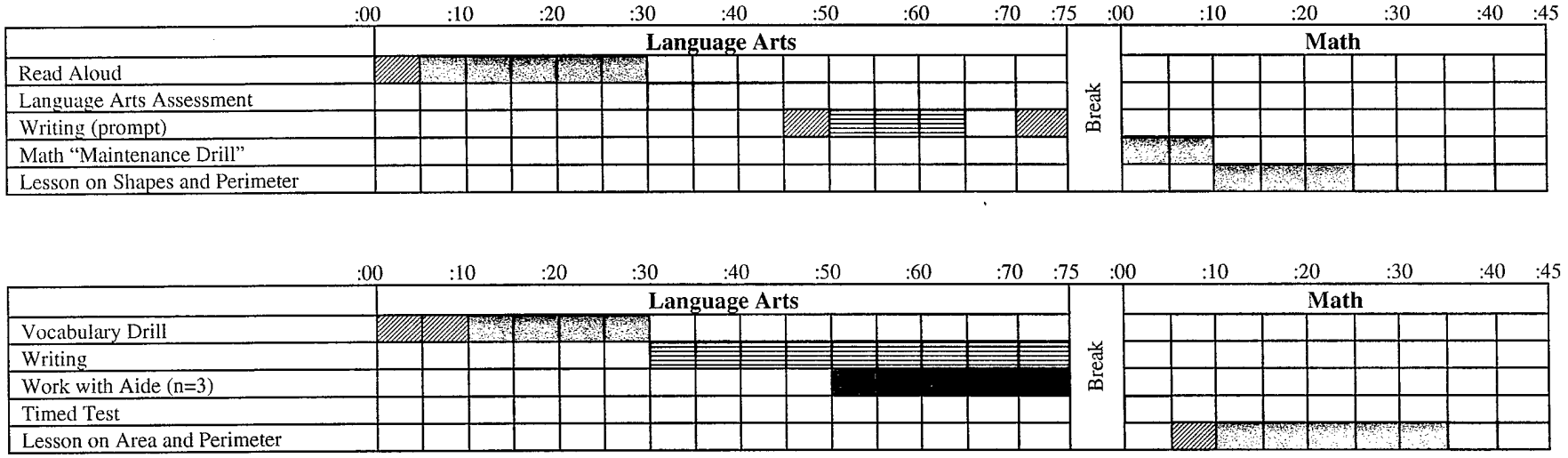
Figure 3. Ms. King, Small, Lesson 4



Key

- Independent Work
- Whole Class Instruction
- Group Work (Pairs or Small Groups)
- Small Group Instruction with Teacher
- Small Group Instruction with Aide/Volunteer
- Transition
- One-on-One Teacher-Student Interaction

Figure 4. Ms. Lane, Large, Lesson 1 and 2

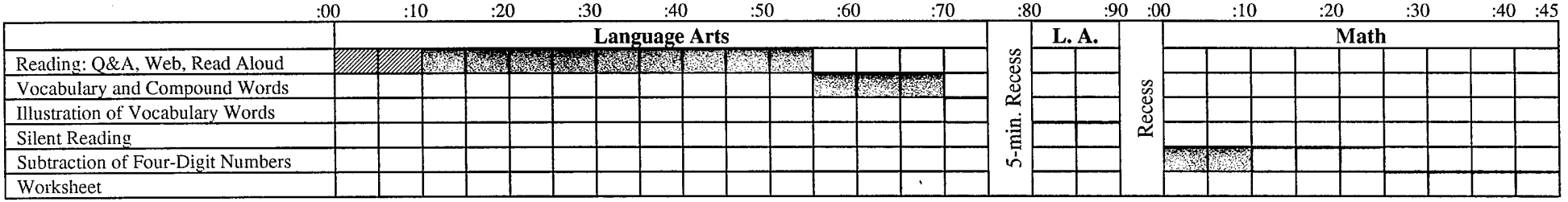


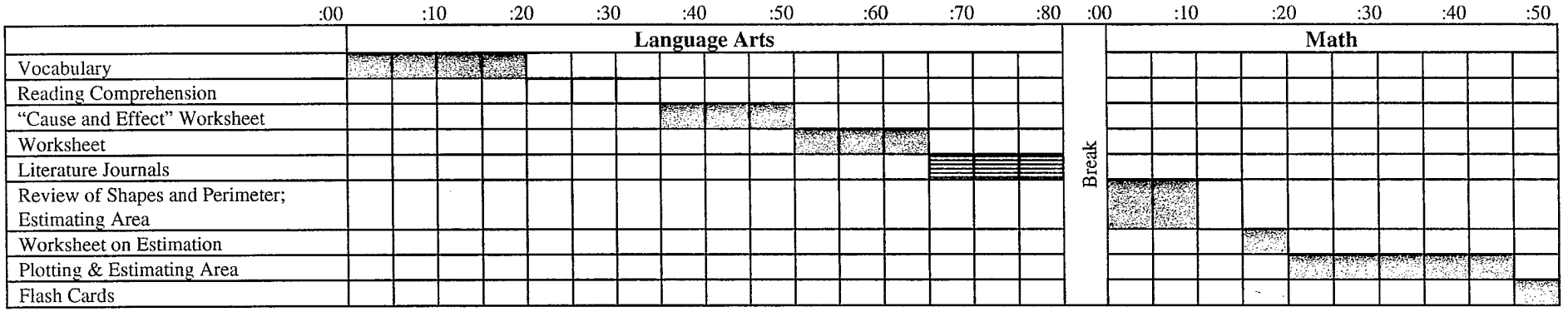
Note: This teacher usually does a mid-morning phonics/language lesson (during the break in observation).

Key

- Independent Work
- Whole Class Instruction
- Group Work (Pairs or Small Groups)
- Small Group Instruction with Teacher
- Small Group Instruction with Aide/Volunteer
- Transition
- One-on-One Teacher-Student Interaction

Figure 5. Ms. Lane, Small, Lesson 3 and 4





Key

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